

Claims

[c1]

What is claimed is:

1. A passive harmonic mixer for outputting a differential baseband signal according to a differential RF signal received from a first input node and a second input node, comprising:

- a first switch pair for selectively connecting a first input node to a first output node depending on a first differential local oscillator signal;
- a second switch pair for selectively connecting the first input node to a second output node depending on a second differential local oscillator signal;
- a third switch pair for selectively connecting a second input node to the first output node depending on the second differential local oscillator signal; and
- a fourth switch pair for selectively connecting the second input node to the second output node depending on the first differential local oscillator signal;

wherein the first and the second input nodes are for receiving the differential RF signal and the first and the second output node are for outputting the differential baseband signal;

wherein the frequency of each of the first differential local oscillator signal and the second differential local oscillator signal is half of the frequency of the differential RF signal;

wherein the phase of the first differential local oscillator signal

and that of the second differential local oscillator signal are shifted by 90 degrees.

- [c2] 2. The passive harmonic switch mixer of claim 1 wherein the first differential local oscillator signal includes a positive in-phase local oscillator signal and a negative in-phase local oscillator signal and the second differential local oscillator signal includes a positive quadrature-phase local oscillator signal and a negative quadrature-phase local oscillator signal.
- [c3] 3. The passive harmonic switch mixer of claim 2 wherein the first switch pair includes a first switch for selectively connecting the first input node to the first output node depending on the positive in-phase local oscillator signal and a second switch for selectively connecting the first input node to the first output node depending on the negative in-phase local oscillator signal.
- [c4] 4. The passive harmonic switch mixer of claim 2 wherein the second switch pair includes a third switch for selectively connecting the first input node to the second output node depending on the positive quadrature-phase local oscillator signal and a fourth switch for selectively connecting the first input node to the second output node depending on the negative quadrature-phase local oscillator signal.
- [c5] 5. The passive harmonic switch mixer of claim 2 wherein the

third switch pair includes a fifth switch for selectively connecting the second input node to the first output node depending on the positive quadrature-phase local oscillator signal and a sixth switch for selectively connecting the second input node to the first output node depending on the negative quadrature-phase local oscillator signal.

- [c6] 6. The passive harmonic switch mixer of claim 2 wherein the fourth switch pair includes a seventh switch for selectively connecting the second input node to the second output node depending on the positive in-phase local oscillator signal and an eighth switch for selectively connecting the second input node to the second output node depending on the negative in-phase local oscillator signal.
- [c7] 7. The passive harmonic switch mixer of claim 1 wherein each switch of the first, the second, the third, and the fourth switch pairs is a MOS transistor.
- [c8] 8. The passive harmonic switch mixer of claim 1 wherein each switch of the first, the second, the third, and the fourth switch pairs is a BJT transistor.
- [c9] 9. The passive harmonic switch mixer of claim 1 set in a super heterodyne receiver.
- [c10] 10. The passive harmonic switch mixer of claim 1 set in a super heterodyne transmitter.

- [c11] 11. The passive harmonic switch mixer of claim 1 set in a direct conversion transmitter.
- [c12] 12. The passive harmonic switch mixer of claim 1 set in a direct conversion receiver.
- [c13] 13. The passive harmonic switch mixer of claim 1 wherein the differential RF signal includes a positive RF signal and a negative RF signal.
- [c14] 14. The passive harmonic switch mixer of claim 1 wherein the differential baseband signal includes a positive baseband signal and a negative baseband signal.
- [c15] 15. The passive harmonic switch mixer of claim 1 wherein the mixer further includes a first capacitor connected to the first input node and a second capacitor connected to the second input node for DC isolation.
- [c16] 16. A direct conversion receiver for outputting a differential baseband signal including a positive baseband signal and a negative baseband signal according to a differential RF signal including a positive RF signal and a negative RF signal, comprising:
an RF amplifier for amplifying the differential RF signal and outputting an amplified differential RF signal;
a local oscillator for outputting an in-phase differential local oscillator signal including a positive in-phase local oscillator

signal and a negative in-phase local oscillator signal;

a phase generator for outputting a first in-phase differential local oscillator signal including a first positive in-phase local oscillator signal and a first negative in-phase local oscillator signal and a first quadrature-phase differential local oscillator signal including a first positive quadrature-phase local oscillator signal and a first negative quadrature-phase local oscillator signal according to the in-phase differential local oscillator signal, wherein the frequency of each of the in-phase differential local oscillator signal and the quadrature-phase differential local oscillator signal is half of the frequency of the differential RF signal, and the phase of the in-phase differential local oscillator signal and that of the quadrature-phase differential local oscillator signal are shifted by 90 degrees;

a phase shifter for outputting a second in-phase differential local oscillator signal including a second positive in-phase local oscillator signal and a second negative in-phase local oscillator signal and a second quadrature-phase differential local oscillator signal including a second positive quadrature-phase local oscillator signal and a second negative quadrature-phase local oscillator signal according to the in-phase differential local oscillator signal by shifting the phase of the corresponding local oscillator signals by 45 degrees;

a first passive harmonic mixer for outputting the in-phase

differential baseband signal from a first output node and a second output node according to the amplified differential RF signal received from a first input node and a second input node, wherein the first passive harmonic mixer comprises:

- a first switch pair including a first switch for selectively connecting the first input node to the first output node depending on the first positive in-phase local oscillator signal and a second switch for selectively connecting the first input node to the first output node depending on the first negative in-phase local oscillator signal;
- a second switch pair including a third switch for selectively connecting the first input node to the second output node depending on the first positive quadrature -phase local oscillator signal and a fourth switch for selectively connecting the first input node to the second output node depending on the first negative quadrature-phase local oscillator signal;
- a third switch pair including a fifth switch for selectively connecting the second input node to the first output node depending on the first positive quadrature -phase local oscillator signal and a sixth switch for selectively connecting the second input node to the first output node depending on the first negative quadrature-phase local oscillator signal; and
- a fourth switch pair including a seventh switch for selectively connecting the second input node to the second output node depending on the first positive in-phase local oscillator signal

and a eighth switch for selectively connecting the second input node to the second output node depending on the first negative in-phase local oscillator signal; and

a second passive harmonic mixer for outputting the quadrature-phase differential baseband signal from a third output node and a fourth output node according to the amplified differential RF signal received from a third input node and a fourth input node, comprising;

a fifth switch pair including a ninth switch for selectively connecting the third input node to the third output node depending on the second positive in-phase local oscillator signal and a tenth switch for selectively connecting the third input node to the third output node depending on the second negative in-phase local oscillator signal;

a sixth switch pair including an eleventh switch for selectively connecting the third input node to the fourth output node depending on the second positive quadrature-phase local oscillator signal and a twelfth switch for selectively connecting the third input node to the fourth output node depending on the second negative quadrature-phase local oscillator signal;

a seventh switch pair including a thirteenth switch for selectively connecting the fourth input node to the third output node depending on the second positive quadrature-phase local oscillator signal and a fourteenth switch for selectively connecting the fourth input node to the third output node

depending on the second negative quadrature-phase local oscillator signal; and
an eighth switch pair including a fifteenth switch for selectively connecting the fourth input node to the fourth output node depending on the second positive in-phase local oscillator signal and a sixteenth switch for selectively connecting the fourth input node to the fourth output node depending on the second negative in-phase local oscillator signal.

[c17] 17. The passive harmonic switch mixer of claim 16 wherein each switch of the first, the second, the third, the fourth switch, the fifth, the sixth, the seventh, and the eighth switch pairs is a MOS transistor.

[c18] 18. The passive harmonic switch mixer of claim 16 wherein the mixer further includes a first capacitor connected to the first input node and a second capacitor connected to the second input node for DC isolation.